Tips & tricks

FERMENTIS

A GUIDE ON YEAST AND FERMENTATION FOR CRAFT BREWERS

Contents

Fermentis is proud to present "**Tips and Tricks**", its guide on yeast & fermentation specially imagined for craft brewers. The purpose of this project is to give you useful technical tips and genuine recipes to use our different types of dry brewing yeast. They will **give you the basic keys to create your own beer.** Because each beer is special and each craft brewer has his secrets, Fermentis chose basic recipes to give you the opportunity to add your personal touch to it. Never forget that the beer you will produce will depend on the brewing conditions defined by raw materials, water, equipments... **Make a beer that tastes like you!** The content of our guide is also downloadable from the craft brewers section of www.fermentis.com. The recipe section will be updated with new recipes on a regular basis. Ales, lagers or speciality beer recipes... visit our site to see the new recipes Fermentis has imagined for you!

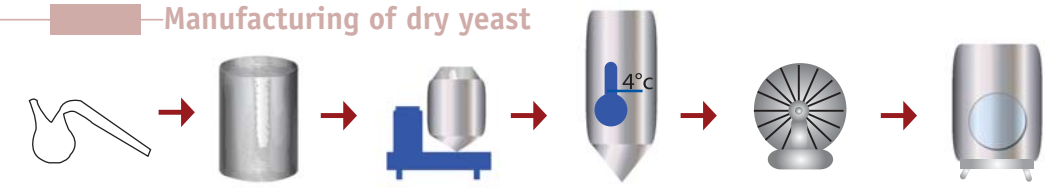
Beer yeast for *craft brewing*

The craft brewing segment has developed and adapted to the consumers' tastes and today offers a large variety of beer styles.
This variety of beer styles now produced by the craft brewing market adds to the difficulty of yeast management, especially in the smaller brewery where the resources of both time and equipment are limited. Beer quality and consistency between batches are critical in meeting customers' expectations.

To assist brewers in achieving these goals, Fermentis supplies a range of true brewer's yeasts in a ready to pitch, dry form. The yeasts are produced in dedicated, state-of-the-art propagation facilities and then carefully dried to preserve their characteristics.

Fermentis was the first manufacturer to dry true lager yeasts. Our different strains are available from recognised European sources enabling high quality lager production. A range of speciality ale yeasts has also been developed to produce ales with authentic flavour profiles.

Manufacturing of dry yeast



All Fermentis dry yeasts offer a long shelf life giving advantages in both distribution and storage. Rehydration is a simple procedure and correct yeast counts are achieved by pitching a known weight of yeast to the wort. No propagation or laboratory input is needed for successful pitching. The microbial quality is assured through careful monitoring during manufacture. Rapid fermentations also add the advantage of predictable fermentation output, essential for good planning in a busy brewery.

PRODUCT RANGE FOR CRAFT BREWING

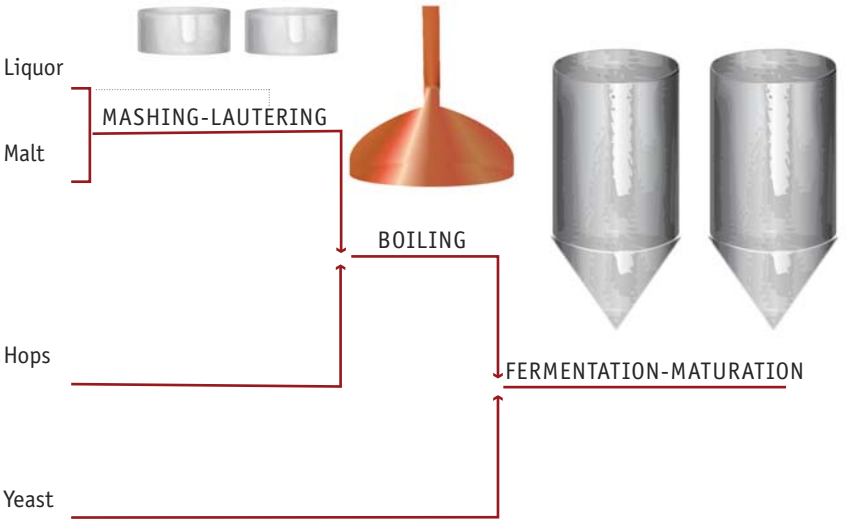
Safbrew: For general and speciality beer production
Safbrew T-58 Safbrew S-33 Safbrew WB-06

Safale: Both top and bottom flocculent ale yeasts to provide the choice for brewing the perfect ale
Safale S-04 Safale US-05 Safale K-97

Saflager: Suitable for all lager and pilsen beers
Saflager S-23 Saflager S-189 Saflager W-34/70

Each of these strains is available in 500 gram sachets.
An ideal packaging for craft brewing purposes.

Yeast and *brewing*



This diagram shows the most important steps in beer production and at which stage each ingredient enters the process. Yeast affects fermentation and subsequent steps of beer production. Still, there are several other factors already determined in the brew house stage, which will influence the final taste of the beer.

Those important factors strongly influencing beer characteristics are:

- Liquor minerals
- The malt bill
- The hops
- The mash, the lauter, the hopping process
- The brewery fermentation conditions

Brewers can still influence their beer at the fermentation stage. Through the following pages Fermentis will give you an insight on how this can be done, depending on the yeast you select, the way you rehydrate your yeast, the pitching method you use, the temperature control during the process, not forgetting the good practices required to manage your yeast.

Effects of pitching rate

The objective is to pitch a sufficient number of viable yeast cells to colonise the wort rapidly. With Fermentis you can accurately convert the cell counts into dry yeast weight.

	Target cell count in wort	Fermentis Yeast Dosage
ALE YEAST	4-6E06 cells/ml	50-80g/hl (0.06-0.10 oz/gal)
LAGER YEAST*	8-12E06 cells/ml	80-120 g/hl (0.10-0.16 oz/gal)

*Values given are for fermentation between 12-15°C (53-59°F).
The yeast dosage should be increased at temperatures below 12°C (53°F), up to 200 to 300g/hl (0.26-0.40 oz/gal.) at 9°C (48°F).

Low pitching rate

Using a low pitching rate will have the effect of slowing the start of the fermentation and increasing the competition from bacteria and wild yeast that are present in the fermentation vessel. It has been noticed that using a low pitching rate amplifies undesirable aroma levels such as acetaldehyde that reveal green apple and grassy aromas as well as ester levels that are characterized by fruity banana flavours.
Combined with a low removal rate of the yeast, a low pitching rate will increase diacetyl. Diacetyl levels will also increase in case of a pediococcus infection. Additionally, at higher pH, the growth of bacteria will influence the increase of Dimethyl Sulphide.

High pitching rate

A high pitching rate generates high heat and influences the rapidity of the start of fermentation. A high pitching rate will decrease the pH and help reduce the bacterial growth; in the same way, diacetyl formation is reduced.

Rehydration

Before dry yeast cells can start fermenting, they need to absorb the water they lost during the drying process. The picture below illustrates how the yeasts will act to recover their shape as they replenish with water.

The rehydration step is done in a vessel outside the fermenter. The objective is to reduce the lag phase: the time necessary for yeasts to start fermenting sugars to alcohol after pitching/inoculating the wort. This is done by rehydrating at a higher temperature than the initial fermentation temperature.

Yeasts are living organisms and rehydration temperature is critical for good yeast performance. Fermentis recommends that top fermenting/ale yeasts are rehydrated at a temperature between 25-29°C (77-84°F) and that bottom fermenting/lager yeasts are rehydrated at a temperature range between 21-25°C (69-77°F).

Rehydrate the dry yeast into yeast cream by sprinkling it in 10 times its own weight of sterile water or wort. Gently stir and leave for 30 minutes. Finally, pitch the resultant cream into the fermentation vessel.

Water or Wort?

Fermentis yeast can be rehydrated with sterile water or sterile wort. Whatever media is chosen it is compulsory to assure its sterility.

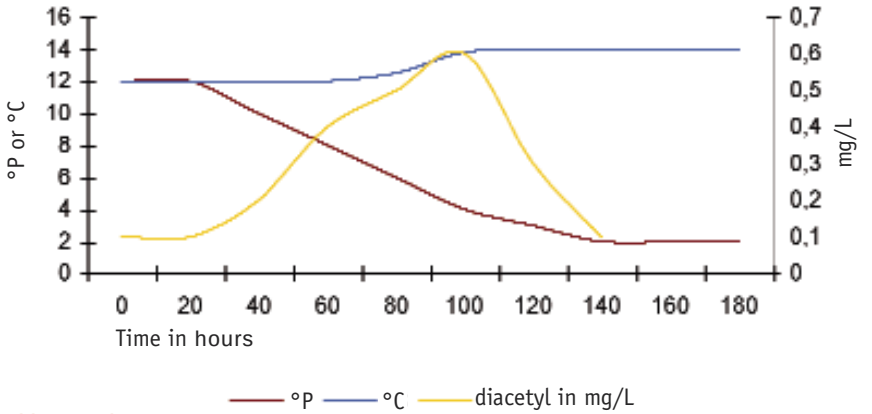
After the wort has been boiled for at least 15 minutes collect the volume required for rehydration and leave to cool to the required temperature. Rehydrate the yeast for 30 minutes. The rehydration should end at the same time as you start transferring the wort to the fermentation vessel. Pitch immediately into the tank after checking the temperature of wort.

Temperature during fermentation

Temperature is an important factor for the success of fermentation. The recommended temperature (refer to product packaging or specification sheets) of each strain should be respected. The warmer the temperature is at the beginning of the fermentation, the faster the fermentation will start. Using higher temperatures for your brew will increase the ester and diacetyl formation. It is recommended to set attemperation in order to control top temperatures. Also for the reabsorption of diacetyl it may be necessary at the end of fermentation to allow the temperature to rise. Low temperature is to be used at the end of the fermentation to achieve good yeast flocculation.

	TYPICAL LAGER	TYPICAL ALE
Start temperature	12°C (53.6°F)	18-20°C (64.4-68°F)
Top Temperature	15°C (59°F)	21-23°C (69-73°F)
Diacetyl rest temperature	15°C (59°F) for 24-48 hours	Decrease temperature from 20°C (68°F) to 16-17°C (60-62°F) for 24 hours
Chill temperature	1-3°C (33-37.5°F)	1-5 °C (33-41°F) chilled & filtered 0-12°C (50-53.6°F) for cask conditioned

Time in hours



Effect of oxygen

Oxygen is required to assure a healthy cell multiplication. Oxygenation is either made by top filling and splashing wort against the wall of the fermenter, aeration or direct oxygen injection. It is usually recommended to make the oxygenation on cooled wort. At this stage hygiene is essential since bacteria may develop during the aeration. Oxygen should only be added in the first twelve hours of fermentation (9 ppm). Adding oxygen during late fermentation will increase aldehyde levels and amplify diacetyl formation. High levels of oxygen will suppress ester production. It has been noticed that oxygen can increase SO^2 concentrations in some worts.

Recovering yeast after fermentation and repitching

Recovering yeast after fermentation and repitching is possible if the cell count is controlled to give the correct yeast pitching levels. In order to control them, laboratory equipment will be needed. In the same way and using the same equipment, bacteria can be removed by acid washing in carefully controlled conditions. In case of repitching, yeast must not be stored out of beer for long periods, even at low temperatures, as yeast glycogen levels will fall causing slow fermentations.

Yeast mutation occurs rapidly in brewing environments, repitching can be a delicate operation and may cause beer quality problems in terms of flavour, yeast settling, diacetyl absorption.

Effects of repitching can be seen in as few as 3 to 5 brews especially concerning diacetyl reabsorption. For ale beers that are generally more flavoursome diacetyl levels are less critical.

Fermentation top pressure

If pressure is applied above 1 bar a formation of higher esters is visible. This can also happen in tall fermentation vessels due to pressure. On the contrary, open or shallow vessels will give lower ester levels.

Yeast *characteristics*

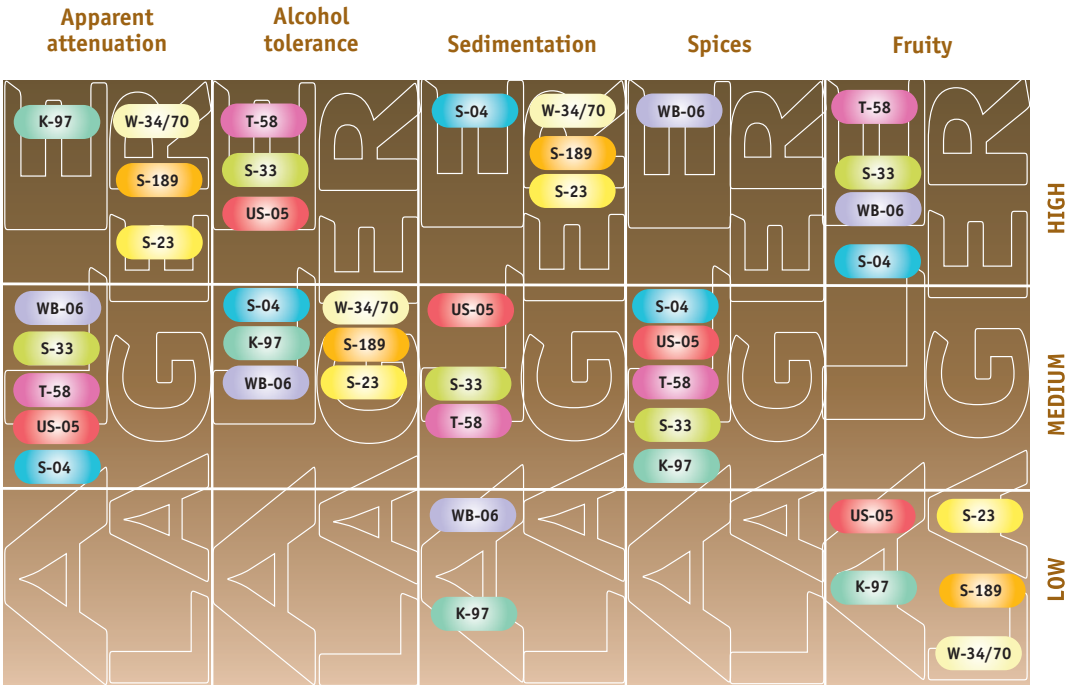
Each beer has its particular characteristics. Whether you are willing to make a mild ale or a stout, flavour or estery notes resulting from your brew will be different. Fermentis classified its different yeasts to help you find which yeast is best adapted for your next brew.

Based on the beer and yeast characteristics, the table shows how the Fermentis range can be used to brew a variety of beer styles.
Yeast should be chosen based on its functional characteristics and on how it will influence the beer.

Ale — Safale

Lager — Saflager

Speciality beers — Safbrew



S-04	Ordinary Bitter, English Pale Ale, Indian Pale Ale, Scottish Ale, Light Porter, Classic Stout
K-97	Ale, Wheat Beers
US-05	Kölsch, Mild Ale, American Pale Ale, Brown Ale, Scottish Ale Light, Porter, Classic Stout
S-23	Dortmunder
S-189	Bock, Dark Munich, Doppelbock
W-34/70	Pilsner, Light Munich, Vienna, Marzenbier, Oktoberfest
S-33	Scottish Ale Export & Strong, Foreign Stout, Barley Wine, Strong Bitter
T-58	Imperial Stout, Barley Wine, Cask and bottle conditionned
WB-06	Wheat Bier, Weizen Bier

Tips of *use*

Stuck fermentations

If the wort does not attenuate fully, there are two possible areas of concern:
a) Brewhouse
b) Fermentation
Try adding new dry yeast of the same strain to a small quantity of wort and aerating vigorously. Leave in a warm room for 24 hours and recheck the gravity to see if the wort can ferment further. If it does, changing the yeast generation for a new one will correct the problem. If there is no change, the wort is not fully fermentable and the fault is in the brewhouse procedures/raw materials leading to an unfermentable wort.
If a brew is seen to be slow fermenting, discard the yeast and pitch with another generation.
Avoid pitching yeast recovered from very high gravity fermentations if possible.

Diacetyl reduction

- Allow to rest at higher temperature for 24-48 hours to allow for reduction
- If high diacetyl is suspected, rouse gently with Nitrogen or CO2 (not oxygen). This will resuspend the yeast into the beer, accelerating reduction. Allow for resettling on cooling
- Do not pitch old generation yeast or yeast that has been slow to ferment previously as reabsorption is faster with healthy yeast.

Original gravity (°Plato)

Prior to fermentation, take the measurement of specific gravity of your wort using an hydrometer. During this measurement, your wort needs to cool at 20°C (68°F). Thanks to our fermentation spreadsheet, you can follow the gravity's progress every day during the fermentation.
Reminder:
°P=GU/4 (cf. glossary)

How to determine the attenuation limit ? In bottle or cask secondary fermentation.

If you choose to do secondary fermentation whether in bottle or cask, it is key to determine the attenuation limit to reach the right carbon dioxide content in the bottle or the cask. Here is a simple test to do on each fermentation vessel just after pitching the yeast to determine the attenuation limit.
This test can easily be done in 750 ml (0.20gal):

- Fill a 750 ml sterilized bottle with wort.
- Add one tea spoon of the yeast used in main fermentation and add a cotton stopper.
- Shake vigourously
- Store at room temperature (20-25°C / 68-77°F)
- Measure the density after 24 hours
- Every 24 hours measure the density.

Once it is the same two days in a row, you have reached the attenuation limit.

pH measurement

PH measurements are usely made at 20°C (60°F).
The first measurement should be processed at the end of sacharification (done at 72°C / 161.6°F).
The pH of the beer's wort must be 5.2 to 5.4. If it is above 5.4, some mineral acid (HCl or H_2SO_4) or organic acid (lactic acid) can progressively be added. The second measurement should be processed prior to the boiling time (100°C/212°F) and the pH should then be 5.0 to 5.2.
If the pH is above correct with acid. At this stage, the wort is very warm so it needs to be cooled very quickly.
When measuring pH, always remember to cool the mash fairly quickly (before the last stage of mashing, which often occurs at 78°C/172°F). NB: If you use acid malt, addition of acid.

icks

Wort transfer

During lautering/sparging, a loss of heat from the wort can be noticed. This happens during the transfer of wort from the mash tun to the lauter tun. It can be avoided by heating the different tuns prior to each transfer. It will also prevent spent grains from forming a sort of jelly. Also avoid cooling the mash during the lautering.
Warning: sometimes it may be necessary to sparge one more time, to obtain the final volume of wort: 1 Kg (1lb) of spent grains retains 0.90L (0.108 gal) of wort.

Iodine starch conversion test

After saccharification (mashing), to check if the starch was converted into fermentable sugars, use an iodine solution. **Take a sample of wort at 72°C (161.6°F) and put it on a porcelain plate.** Then, lay down a drop of iodine solution and observe the result. If the wort's coloration becomes blue, the saccharification didn't finish: there is still starch in the wort. You need to **stay at 72°C (161.6°F) a few minutes more**. If the coloration is yellow, all the starch has converted into sugars.

Brewery hygiene

Hygiene is essential in all fermenting rooms.
A few keys to have the best hygiene:
Pitch the wort as soon as possible, once its temperature is steady. Use terminal sterility on cleaned tanks. Always make sure that the vessel valve and outlets are clean, flooding it with detergent. After cleaning the vessels, these should be kept sealed.
Use a hygienic soak bath to wash your ustensils.
For those working on open tanks, if infection is possible from the environment (dust, old buildings, flies) cover the vessel with polythene sheeting, secured tightly. Make a few ventilation holes to allow the evacuation of gas.
Do not repitch the yeast. Always use new yeast for your brew.

Glossary

A few definitions to learn more about brewing.....

A

Alcohol By Volume (v/v): The percentage of volume of alcohol per volume of beer. To calculate the approximate volume content apply the following method:

Original Gravity – Final Gravity = X
X / 0.0075 = % v/v

Ale: Historically, an unhopped malt beverage. Ale now is used as a generic term for hopped beers produced by top fermentation.

Alpha-Acid Unit (AAU): Measurement of the potential bitterness of hops, expressed by their percentage of alpha acid. Low: 2-4%; medium: 5-7%; high 8-12%.

Attenuation: Measurement of the quantity of sugar in the wort that has been fermented by the yeast into alcohol and carbon-dioxide gas.

C

Carbonation: Process of introducing carbon-dioxide gas into a liquid by:

- injecting the finished beer with carbon-dioxide
- adding young fermenting beer to finished beer for a renewed fermentation
- priming to fermented wort prior to bottling and creating a secondary fermentation in the bottle
- finishing fermentation under pressure

Colour: There are two different analytical methods SRM (Standard Reference Method) and EBC (European Brewery Convention) to mesure the colour of wort and beer. SRM units are equivalent to Lovibond degrees and are used by ASBC (Association of Brewing Chemists). EBC are european units.

EBC /1.97 = SRM

D

Density: Measurement of the weight of a solution compared with the weight of an equal volume of pure water.

Dimethyl sulphide (DMS): An important sulphur-carrying compound originating from malt. At low levels, DMS adds a crisp character, at high levels it will add corn or cabbage flavours.

E

Esters: Aromatic compounds from fermentation composed of an acid and an alcohol. Major esters are: Ethyl Acetate - fruity odour and taste - Isoamyl Acetate - banana ester - and Ethyl Hexanoate. Top fermenting yeast strains are preferred for their ability to produce particular mixes of esters.

F

Final specific gravity: The specific gravity a beer has obtained when the fermentation is over.

Flocculation: A very important process that makes the yeast sediment to the bottom of the fermenter at the end of the fermentation. Flocculation normally starts after all the nutrients have been used.

I

International Bitterness Unit (IBU): Standard unit used to measure the concentration of iso-alpha-acids in milligrams per litre.

L

Lager: A long cold period of subdued fermentation and sedimentation subsequent to active primary fermentation.

M

Malt: Barley steeped in water, germinated and dried in kilns. This process converts insoluble starches to soluble substances and sugars.

Mash - Mashing: Process of enzymatically extracting and converting malt solubles to wort, in an acid uric aqueous solution. In infusion mashing, the conversion goes through different phases: the acid rest, the protein rest, saccharification & the lauter rest.

O

Original Gravity: Specific gravity of wort prior to fermentation. Original gravity is the measure of the total amount of dissolved solids in the wort.

P

Plato degrees: Expresses a solution's density in grams of sucrose per 100 grams of solution. Plato degrees are measured at 20°C (68°F).

S

Sparging: Spraying the spent grains in the mash with hot water to remove the remaining malt sugar.

W

Wort: Sweet wort is the mash extract. Bitter wort is the hopped sugar solution before pitching.

Notes

brewing *log sheet*

Beer name:
Beer style:
Batch size: Target OG/°P:

Brew date:
Brewer:
Brew number:

Malt and Adjuncts

Lb/Kg per hL	Ingredients	Colour (SRM/EBC)

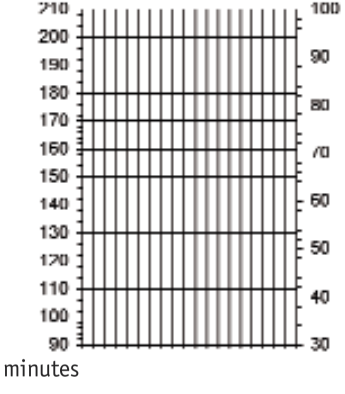
Lautering / sparging

Beginning time: End Time:

Sparging number	Volume (L/Gal)	Temperature (°C/°F)	Time (minutes)

Mashing

Mash time & temperature



Mash type:
Volume of water for washing (L/gal):
Volume of wort (hL):
Iodine Starch Test:

Boiling and hopping

Beginning time: End Time:

% evaporation rate:

Oz/g/hL	Hop / seasoning	% Acid	IBU	Addition time

Gravity (°P):
Whirlpool time:

fermentation *sheet*

Fermenter:

Wort Volume:

Start date:

Type of yeasts:

Generation:

Fermentation temperature (°C/°F):

Pitching rate (g/hL):

Original gravity (°P):

Date / Time	Gravity (°P)	Tank temperature (°C/°F)	Pressure (bar)	Comments

sensory description

Green beer	Ready to drink beer
Date:	Date:
Colour:	Colour:
Odour:	Odour:
Flavour:	Flavour:
Taste:	Taste:

Lagering

Start Date:

Tank temperature (°C/°F)

End Date:

brewing *log sheet*

Beer name:
Beer style:
Batch size: Target OG/°P:

Brew date:
Brewer:
Brew number:

Malt and Adjuncts

Lb/Kg per hL	Ingredients	Colour (SRM/EBC)

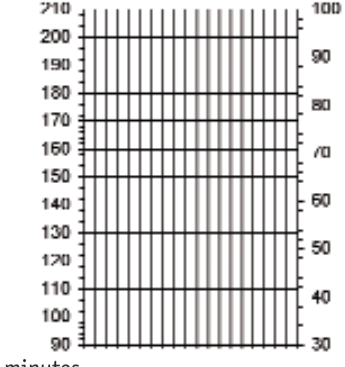
Lautering / sparging

Beginning time: End Time:

Sparging number	Volume (L/Gal)	Temperature (°C/°F)	Time (minutes)

Mashing

Mash time & temperature



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fermentation *sheet*

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sensory description

Green beer	Ready to drink beer
Date:	Date:
Colour:	Colour:
Odour:	Odour:
Flavour:	Flavour:
Taste:	Taste:

Lagering

Start Date:

Tank temperature (°C/°F)

End Date:

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